



CALTRANS REGIONAL OPERATIONS FORUMS

Advanced Corridor Operations
Techniques





How Travelers Use a Corridor

- Travelers view the transportation network as a whole
- When faced with congestion on one facility, travelers may respond by
 - ↳ Selecting a different facility (transit or roadway),
 - ↳ Adjusting their trip to another time of day, or
 - ↳ Remaining on their current route
- Should we manage the corridor to reflect how travelers use it?





Corridor Management

- ▶ Corridors offer opportunities to operate and optimize the entire system
 - ↳ Beyond individual networks
- ▶ Transportation corridors often contain unused capacity
 - ↳ Parallel routes
 - ↳ Non-peak direction
 - ↳ Single-occupant vehicles
 - ↳ Underutilized transit services
- ▶ Managing the corridor can more fully utilize this capacity
 - ↳ Management approaches like ramp metering
 - ↳ Traveler information and outreach



Active Traffic Management

What Is Active Traffic Management?

Traffic management concepts intended to:

- ▶ Enhance roadway safety
- ▶ Reduce congestion
- ▶ Provide reliable trips
- ▶ Provide enhanced information to motorists
- ▶ Leverage available capacity during periods of congestion or incidents



M 42 Speed Harmonization and hard shoulder lane in England. (UK Highways Agency)



Examples of ATM

- ▶ Lane-use control
- ▶ Variable speed limits / advisories
- ▶ Queue warning
- ▶ Dynamic shoulder lane
- ▶ Dynamic re-routing
- ▶ Junction control
- ▶ Adaptive ramp metering

***Active Traffic Management is
not limited to urban areas!***

ATM Simulation



Active Traffic Management Simulation

Scenario 3: Two-Lane Incident
Closure with Congestion



Examples of ATM in the US

- ▶ Seattle
- ▶ Minneapolis
- ▶ I-66 (Northern Virginia)
- ▶ Los Angeles
- ▶ Dallas “Horseshoe”
- ▶ Denver
- ▶ Utah I-80 Parley’s Canyon
- ▶ I-80 (SF Bay Area)
- ▶ New York Long Island Expressway
- ▶ Philadelphia I-95
- ▶ Portland, OR
- ▶ New Jersey
- ▶ I-80 Wyoming
- ▶ Others?

Many examples in Europe and around the world!

ATM in I-80 Corridor



DOWNTOWN SF


VIA  XX MIN

VIA  XX MIN

VIA  XX MIN

SAN JOSE

VIA  XX MIN

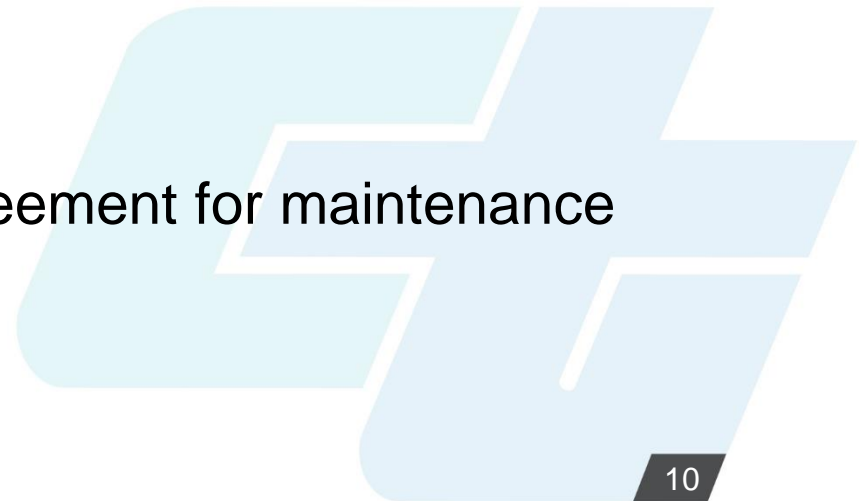
VIA  XX MIN





I-80 Corridor

- ▶ Institutional Environment
 - ↳ 1 DOT, 9 cities, 2 MPOs, 2 transit agencies
 - ↳ Different stages of infrastructure
- ▶ Staging of implementation
 - ↳ Arterials first, freeways next (some delays due to concrete piles)
 - ↳ Some equipment went out of warranty before complete
- ▶ Maintenance
 - ↳ MOU for local agencies
 - ↳ Regional maintenance agreement for maintenance funding



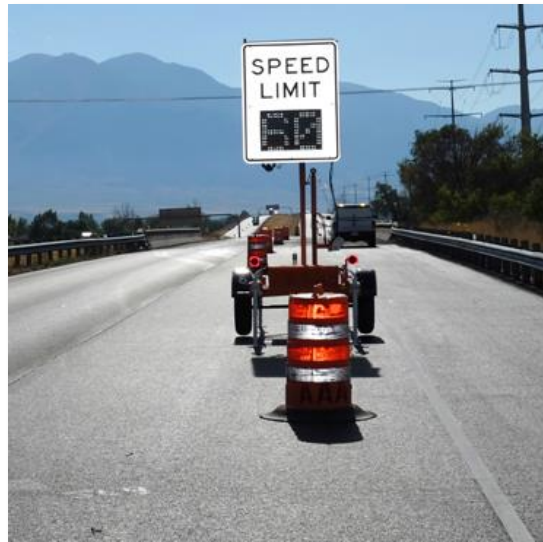
WSDOT's Smarter Highways

- ▶ Variable speed limits, lane control, traveler information
- ▶ Reduce speeds approaching congestion, crashes, work zones
- ▶ Warn motorists of downstream queues
- ▶ Display which lanes are open, closed, and closed ahead
- ▶ Primary objective is safety improvement



The Use of ATM is Expanding

- ▶ Rural/non-urban applications
- ▶ ATM is compatible with other combined, integrated approaches
 - ↳ Traffic incident management
 - ↳ Work zone traffic management
 - ↳ Managed lanes





Dynamic Shoulder Use

- ▶ Inside shoulders along I-66 in Virginia
- ▶ Adjusted in real-time based on traffic conditions
- ▶ When shoulder is open, display on the gantry above it has a green arrow; when closed, it has a red 'X'
- ▶ Also coloring shoulder pavement a red clay color to highlight the special use lane





Dynamic Shoulder Use

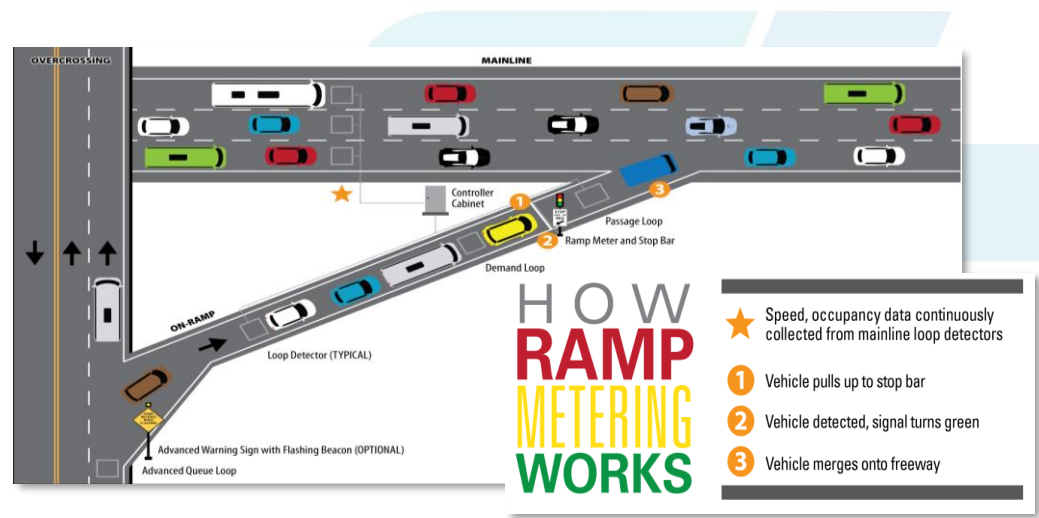
- ▶ I-35 in Minneapolis, MN – 1st dynamic shoulder application the Country (2009)
 - ↳ Dynamic priced lanes – buses, vanpools, carpools and MnPass users
 - ↳ 2.5 miles with static and changeable signs every 0.5 miles
 - ↳ After first year of implementation, pulled an average of 50,000-60,000 month trips from GP lanes





Ramp Metering

- ▶ Reduces overall freeway congestion by managing the amount of traffic entering the freeway and by breaking up platoons
- ▶ Algorithm determines entrance rate based on mainline volume, speed, queue length
 - ↳ Objective is to limit the amount of traffic entering freeway to minimize flow breakdown
- ▶ Widely used throughout California
- ▶ What about the US 101 corridor?





Ramp Metering Benefits

- ▶ Mobility, Reliability, and Efficiency
 - ↳ Reduced travel times
 - ↳ Increased travel time reliability
 - ↳ Increased mainline speeds
- ▶ Safety
 - ↳ Crash reduction
- ▶ Reduced Environmental Impacts
 - ↳ Reduces stop-and-go conditions
 - ↳ Less fuel consumed
- ▶ Low cost with High Benefit/Cost Ratio
 - ↳ Cost effectiveness
 - ↳ Twin Cities metering had B/C ratio of 15 : 1
- ▶ Probably the most proven freeway management strategy
 - ↳ Leverage ITS infrastructure
 - ↳ Reduced environmental documentation

What is ODOT RealTime?

ODOT RealTime is a comprehensive system of automated technologies to improve the operations of the freeway system. Goals of this system are to provide traveler information and to improve safety and travel time reliability.



217 Benefits of Ramp Metering



The Upgraded Ramp Metering System was the first tool from the ODOT RealTime system to be implemented last year on Highway 217. The existing ramp meters throughout the corridor were upgraded to a new and improved adaptive system.

The benefits of the upgraded adaptive ramp metering system include decreasing travel times and improving travel-time reliability with no impact to vehicle throughput.

In addition to Highway 217, the upgraded adaptive ramp metering system has now been deployed throughout the Portland Metro area.

**TRAVEL TIME
RELIABILITY**
IMPROVED BY **19%**



Commute times became 19% more consistent, making it easier to arrive on time.

**TRAVEL
TIME**

**REDUCED
13% AM
7% PM**

TOTAL DELAY

**REDUCED
33%**



Public Perception Challenges

- ▶ Understanding of Purpose and Benefits
- ▶ Metering during congested vs non-congested time-of-day
- ▶ Comparisons to adjacent ramp conditions
 - ↳ Wait Time
 - ↳ Cycle Length
- ▶ Metering congested vs non-congested roadways

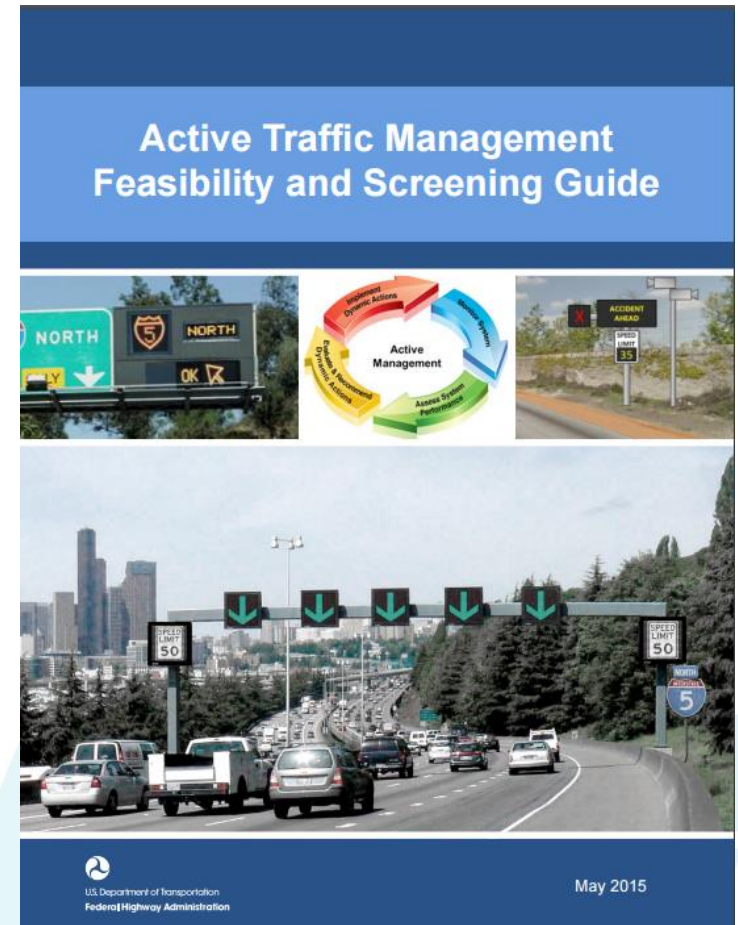


Is ATM the Right Solution?

- ▶ ATM sounds great! How do I get started?
- ▶ Important considerations:
 - ↳ What roadway networks and facilities would be best suited for ATM in my region?
 - ↳ What specific or combination of ATM strategies would work best?
 - ↳ What would be the range of expected benefits?
 - ↳ What would be the expected costs (capital and ongoing)?

Guidance Document

ATM Feasibility and Screening Guide



<http://www.ops.fhwa.dot.gov/publications/fhwahop14019/fhwahop14019.pdf>



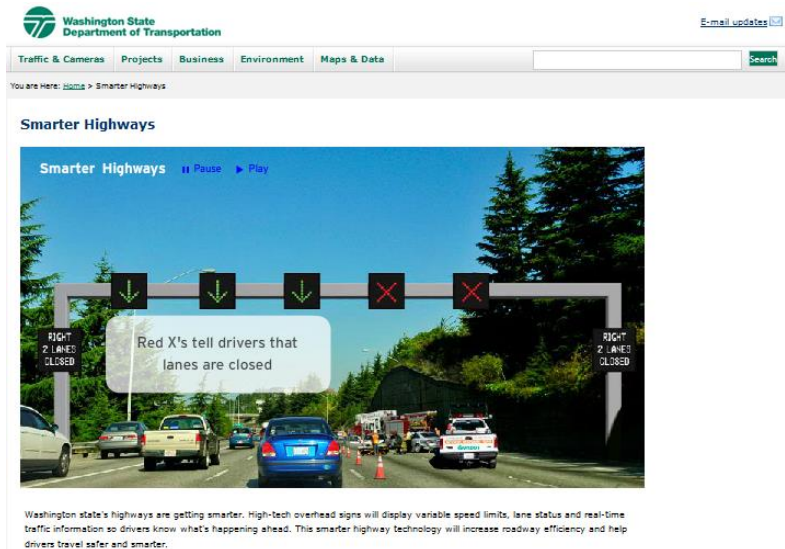
Success Factors

- ▶ High traffic volumes
- ▶ Changes in prevailing conditions
- ▶ High prevalence of crashes
- ▶ Bottlenecks
- ▶ Adverse weather
- ▶ Variability in trip reliability
- ▶ Construction impacts
- ▶ Financial constraints
- ▶ Limitation in capacity expansion



WSDOT Outreach Examples

- ▶ Smarter highways video on Youtube
<http://www.youtube.com/wsdot#p/u/12/cd0doR0Ga-I>
- ▶ Smarter highways www.smarterhighways.com
- ▶ Posted links on Twitter, Facebook and WSDOT blog
- ▶ Outreach to cities, counties, businesses, colleges





Group Discussion

- ▶ What other examples of ATM have you heard about?
- ▶ D5 is considering ramp metering and dynamic shoulders – how will those function as ATM strategies?
- ▶ Any additional ATM strategies that could have a positive impact on operations in the US 101 corridor?



INTEGRATED CORRIDOR MANAGEMENT



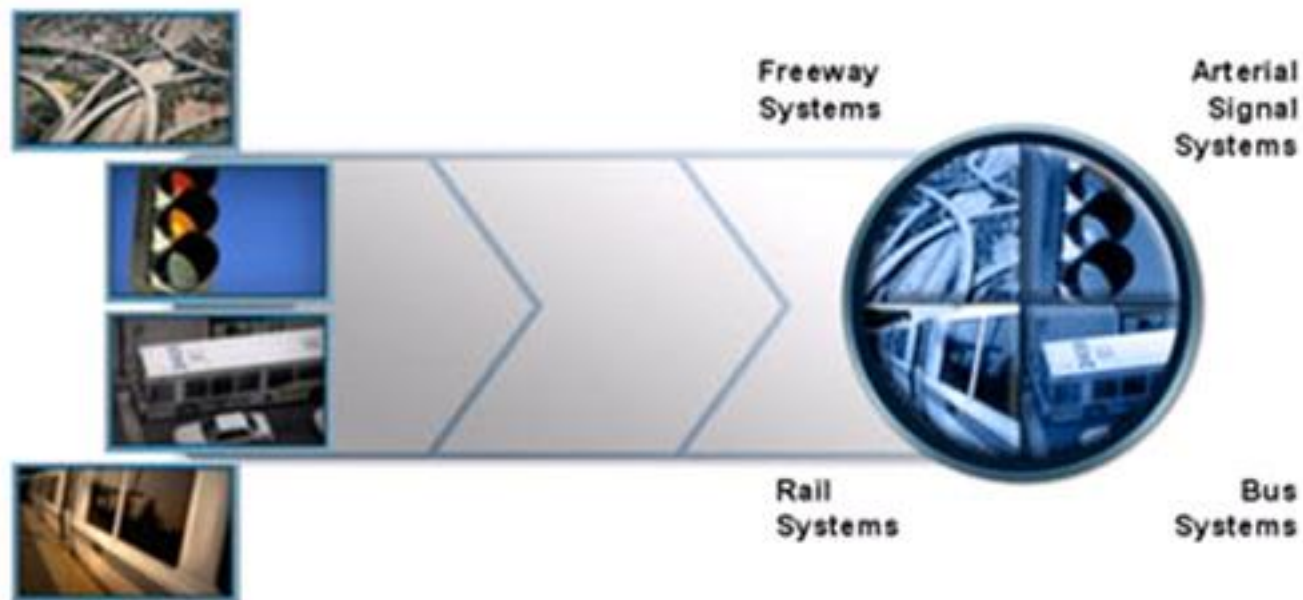


Integrated Corridor Management

- ▶ ICM Background and Concepts
- ▶ Status of the Federal ICM Initiative and Sites
- ▶ Planning for ICM
 - ↳ Stakeholders
 - ↳ Integrating with existing plans and programs
 - ↳ ICM Concept of Operations
 - ↳ Agreements
 - ↳ Modeling and Performance Measures
- ▶ Integration to Support ICM Strategies



What Is ICM?



- ▶ **Maximize corridor capacity through:**
 - ▶ New institutional models
 - ▶ New technology
 - ▶ More dynamic operational strategies



USDOT ICM Initiative

ICM Pilot Sites:

- San Diego, CA
- Dallas, TX

Key Elements:

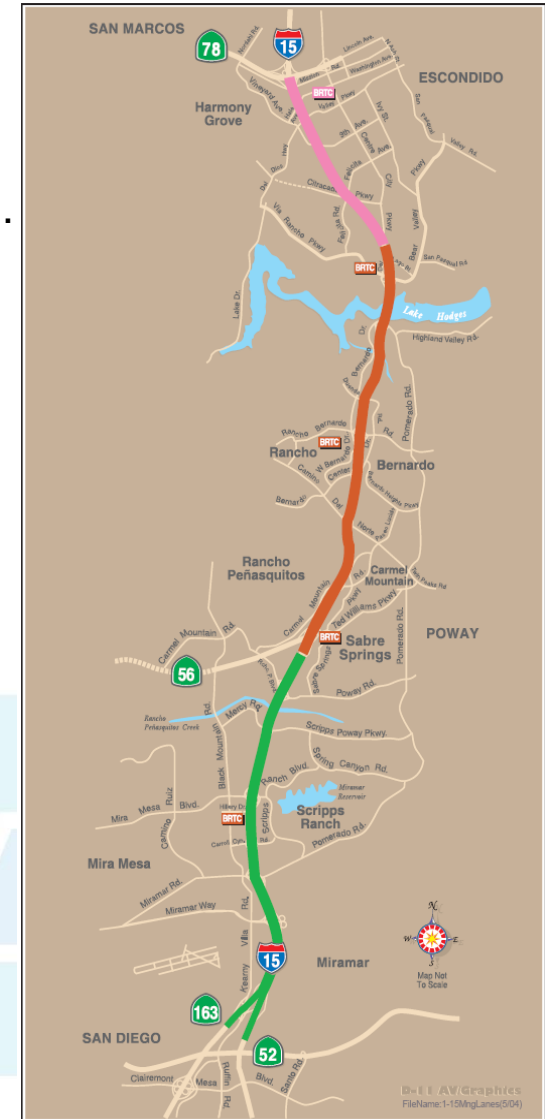
- Decision Support Systems
- Institutional Agreements
- Operational Strategies
- Multimodal

ICM Planning Grants:

- I-10, Phoenix, AZ
- I-210, LA/Pasadena, CA
- SR4, Bay Area, CA
- I-95, Broward Co., FL
- I-95/MD295/US1, Baltimore, MD
- NJ Turnpike and US1
- NYC – multiple corridors
- I-90 Buffalo-Niagra, NY
- I-84, Portland, OR
- IH-10/US-54/IH-110, El Paso, TX
- IH-35, Austin, TX
- I-15, Salt Lake City, UT
- Northern VA – multiple corridors

SANDAG I-15 ICM

- ▶ Primary artery for the movement of commuters, goods, and services from north San Diego County to downtown.
- ▶ I-15 Managed Lanes System
- ▶ Multi Institutional Cooperation/ Partnerships
- ▶ Multi-modal Transportation Improvement Strategies and Mode Shift – BRT, TSP
- ▶ 511, including transit information





I-15 ICM Decision Support “Response Postures”

Response Posture		Event Impact (congestion, construction, incident, etc.)		
		Low	Medium	High
Demand on Network	Light	Conservative	Conservative	Moderate
	Moderate	Conservative	Moderate	Aggressive
	Heavy	Moderate	Aggressive	Aggressive

Demand
Light
<ul style="list-style-type: none"> Weekends Holidays
Moderate
<ul style="list-style-type: none"> Off-peak weekday Minor weekend special event
Heavy
<ul style="list-style-type: none"> Peak-hour weekday traffic

Response Posture
Conservative
<ul style="list-style-type: none"> Example – Provide slight increase to ramp metering rate
Moderate
<ul style="list-style-type: none"> Example – Provide additional green-time to favor northbound traffic while still providing adequate cross-street timing
Aggressive
<ul style="list-style-type: none"> Example – Display alternate route for freeway traffic on CSM, such as “INCIDENT AHEAD NB USE POMERADO”

Event Impact
Low
<ul style="list-style-type: none"> Incident closing freeway shoulder or one lane Construction closing one lane of primary arterial Breakdown of transit vehicle
Medium
<ul style="list-style-type: none"> Incident closing 1 freeway lane Closure of Express Lanes Construction on Pomeroado reducing NB and SB to one lane each direction
High
<ul style="list-style-type: none"> Major incident at intersection of primary arterials Closure of two or more lanes of the freeway Combination of low and medium incidents

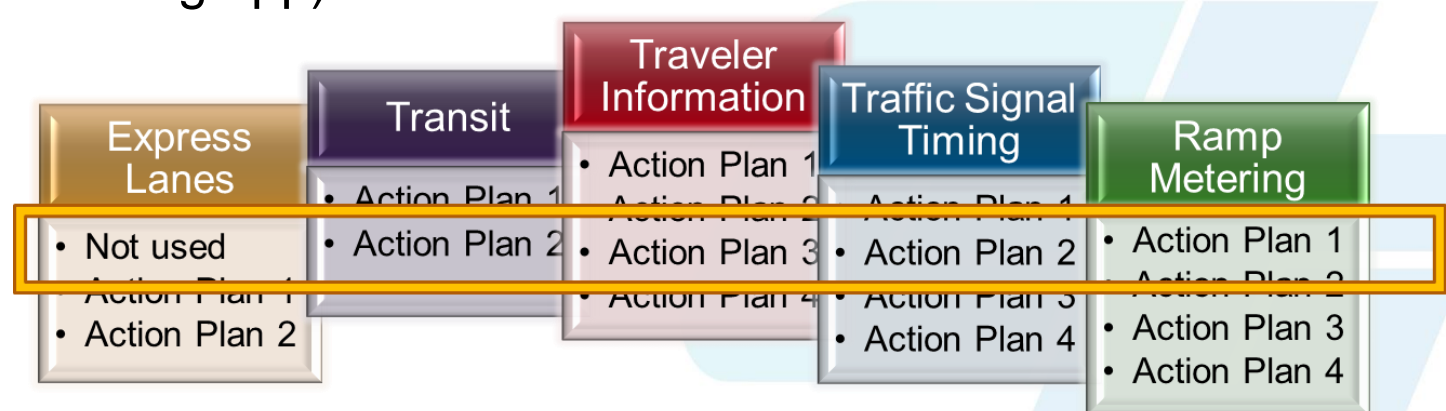


I-15 ICM Response Plans

- ▶ 156 Alternate Routes
- ▶ 260 Local Arterial Intersections
- ▶ 18 Metered Interchanges
- ▶ 20 Dynamic Message Signs
- ▶ 5 BRT stations
- ▶ 20 miles HOT – reversible lanes
- ▶ 30 miles Traffic Responsive
- ▶ 511 (including app)

Limited set of “point-in-time” Response Plans by:

- Using Asset Restrictions
- Using Availability Conditions
- Using Thresholds to select “next move” relationships
- **= 1.5 billion combinations!**





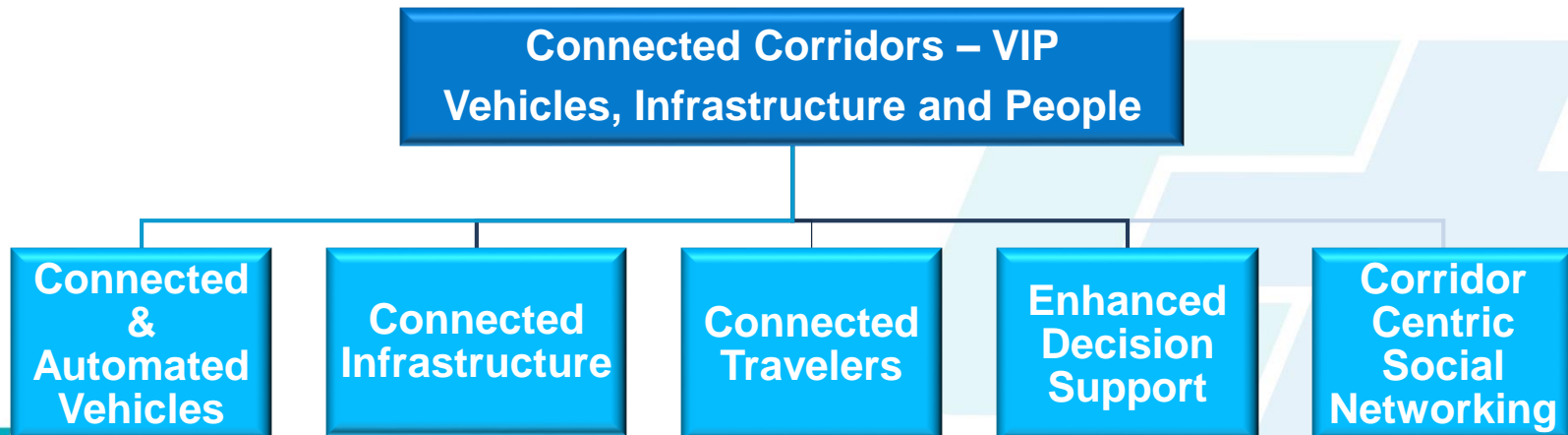
USDOT ICM Status Update

- ▶ San Diego and Dallas went “live” in early 2013
- ▶ Testing and evaluating the DSS in both regions (3-year evaluation)
- ▶ Independent evaluation
- ▶ Early lessons:
 - ↳ Agreements are tough. Most challenging part of ICM.
 - ↳ Data integration from multiple systems and multiple networks
 - ↳ Determining mode shift is difficult, working through how to evaluate effectiveness
 - ↳ Combinations of strategies also are challenging to evaluate



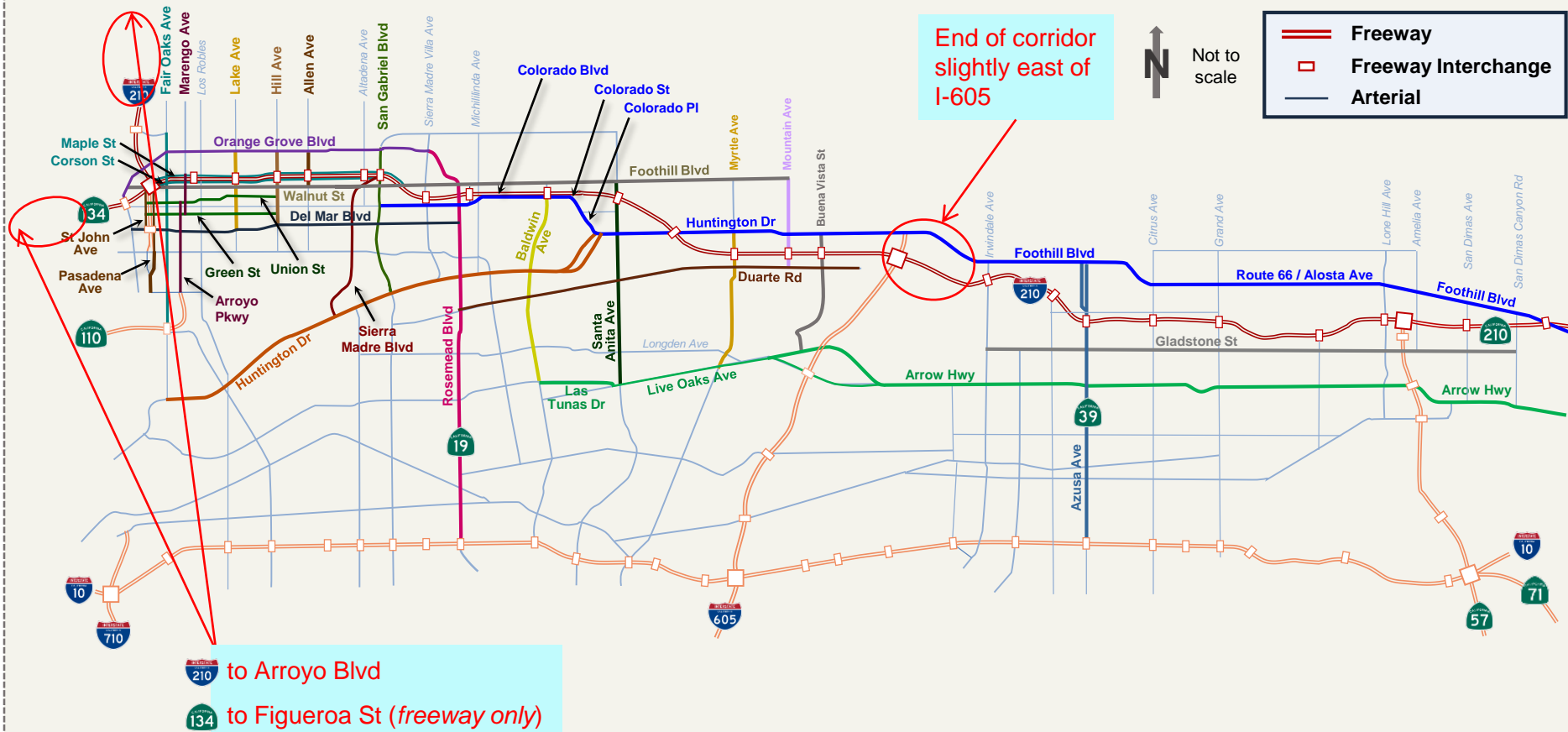
California Connected Corridors

- ▶ Initiated in 2011 – Statewide Framework
- ▶ Focus on planning, implementation, O&M
 - ↳ Implement TSM&O on their most congested corridors (50)
 - ↳ Evolve Caltrans to real-time operations and management
 - ↳ Enhance partnerships
 - ↳ Optimize infrastructure and capacity
 - ↳ Improve overall corridor performance



I-210 Project Corridor (Pilot)

Segment 1 Area of Interest





Stakeholder Roles for ICM

- ▶ Identifying the right partners
- ▶ Key partners
 - ↳ Freeway management and operations – TOC, freeway service patrol, freeway incident response
 - ↳ Arterial management and operations – TOC, signal operations
 - ↳ Transit
 - ↳ Incident response and management – freeway and arterial incident response/law enforcement
 - ↳ MPO – planning
 - ↳ Others to be determined on a regional level based on operational need
- ▶ ***Leadership commitment – key to sustaining partnerships. You already have this!***



Leveraging ICM

- ▶ ITS Plans or Updates/TSMO Planning
- ▶ Traffic Incident Management Coalitions
- ▶ Standing Committee Meetings (ITS Partners)
- ▶ Large-scale freeway or arterial improvement projects
- ▶ TIP funding cycles
- ▶ RTP updates
- ▶ Follow up initiatives from RCTO and other Ops Plans

Plant seeds, build interest, introduce ICM as a collaborative, regional effort

ICM Performance Measures

► National evaluation is looking at the following MOEs:

- ↳ Vehicle and person throughput
- ↳ Travel times and travel time index
- ↳ Standard deviation of travel time
- ↳ 80th, 90th, and 95th percentile travel times
- ↳ Buffer and Planning Indices
- ↳ Traveler Response
- ↳ Safety benefits

► Other ICM Objectives could be...

- ↳ Traveler information
- ↳ TIM
- ↳ Data sharing
- ↳ Institutional participation





Interagency Agreements

- ▶ Essential for ICM and multi-agency operations strategies
- ▶ New operations models, potential for joint operations
- ▶ Data sharing and system connectivity
- ▶ Often, the most complex part of an ICM program and strategy
- ▶ Examples – I-80, SANDAG, AZ
 - ↳ Operating and operating authority
 - ↳ Data sharing parameters
 - ↳ Cost sharing
 - ↳ Decision making

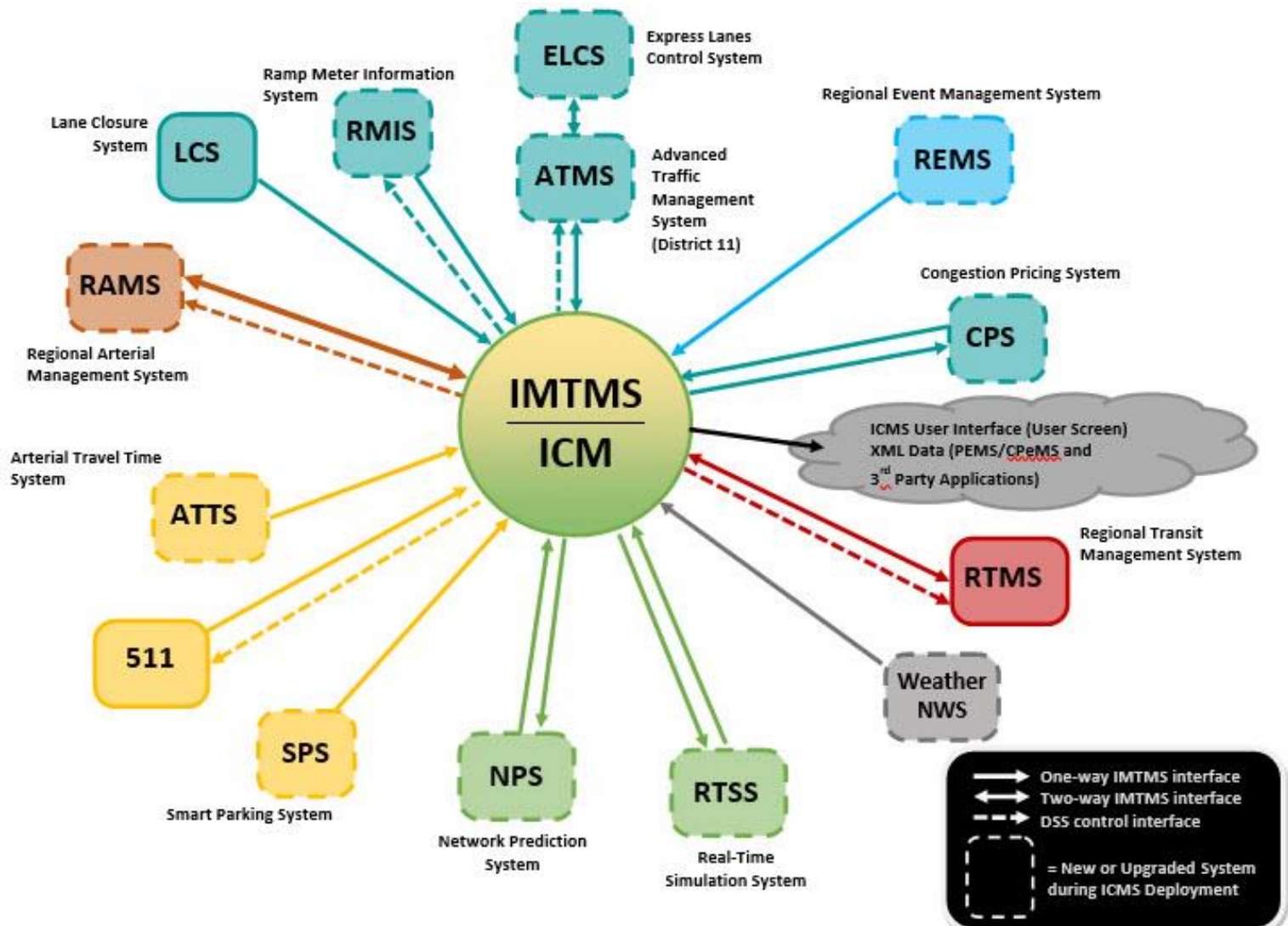




Real-time Data Sharing to Support ICM

- ▶ Regional strategies for sharing data
- ▶ What information do partners need?
- ▶ Operations data to support ICM
 - ↳ Real-time freeway, arterial and transit operations
 - ↳ Real-time strategy implementation information
 - ↳ Agency notifications
- ▶ Overcoming institutional barriers to effective data sharing
 - ↳ SANDAG (San Diego/D11)
 - ↳ RITIS (I-95)
 - ↳ RADS (Arizona)

SANDAG Data Hub





Staffing and Training

- ▶ Staff capacity building
 - ↳ Current staff vs. supplementing staff
 - ↳ Leveraging available regional technical staff resources
- ▶ Staff training needs for ICM and next-generation operations
 - ↳ New systems and new operational approaches
 - ↳ Multi-agency training strategies essential



ICM Resources

▶ California Connected Corridors

↳ <http://connected-corridors.berkeley.edu/>

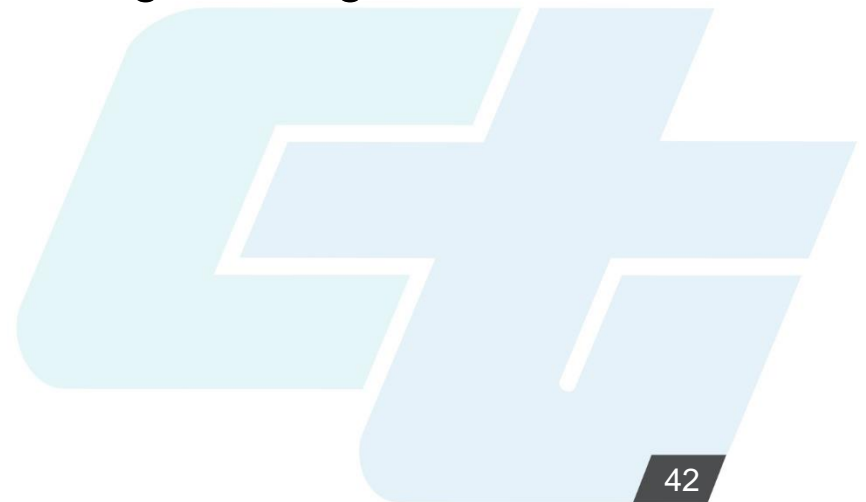
▶ FHWA/USDOT

↳ its.dot.gov/icms

↳ ICM Knowledge and Technology Transfer (KTT)

↳ Guidance documents for each stage – planning, stakeholder engagement, design, test plan, modeling, training, lessons learned

↳ Fact sheets





Advanced Corridor Considerations

- ▶ What is the status of the current ICM planning efforts in D5?
- ▶ What are your initial considerations?
- ▶ How would you go about developing a plan for corridor management?
- ▶ Who would you involve?
- ▶ What technologies/systems/actions would you consider?
- ▶ What are the major gaps or challenges you see in implementing the plan?
- ▶ What would you do to give your plan the best chance of success, especially considering the gaps/challenges?